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BOBCAT FLAT PHASE III PART 1 REDESIGN SALMONID HABITAT EVALUATION

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1 INTRODUCTION

CDFW Proposition 1 grant agreement number Q2196022, which has provided funding for the Bobcat Flat Phase III Part 1 implementation, includes, "creating up to 10.4 acres of juvenile rearing and adult spawning habitat for threatened Central Valley steelhead (*Oncorhynchus mykiss)* and Fall-run Chinook Salmon (*Oncorhynchus tshawytscha*)". During 2022, several design changes were made. Riffle IC-9 was removed from the project per Tuolumne River Conservancy concerns about impacting existing spawning habitat. In addition, the neighboring landowner requested that the proposed IC-6 bar not extend to the left bank (his property). These changes resulted in a need to redesign the original project. The Tuolumne River Conservancy and McBain Associates met with the California Department of Fish and Wildlife on Monday, December 19th, 2022, to discuss the redesign. At that meeting, CDFW stated that the redesign would still need to fulfill the same amount of additional habitat area as described in the grant agreement. Therefore, the redesign only addresses areas that will be constructed in 2023 (or 2024 should high water impact construction in 2023) as part of the grant agreement (Q2196022).

In March 2023 the project was re-designed, based on removing IC-9, modifying IC-6, and adding features in other locations. As shown on Sheet C-2 of the redesigned 100% planset, the project now includes adding 9.4 acres of in-channel spawning gravel, 1.3 of which were constructed in 2022 with IC-7, and the remaining 8.1 acres will be constructed in 2023. In addition, the project will excavate 4.4 acres of side channel, and approximately 10 acres of floodplain. Thus, the project will create new in-channel, floodplain, or side channel habitats on approximately 24 acres. Thus, assuming all side channel and floodplain surfaces are rearing habitat, and that all spawning gravel addition areas are spawning habitat, the redesigned project creates 9.4 acres of spawning habitat and 14.4 acres of rearing habitat, greater than the 10.4 acres funded under CDFW grant agreement number Q2196022. These excavation and gravel addition areas were further evaluated based on the depth, velocity, and cover habitat suitability for Chinook Salmon and *O. mykiss.*

To evaluate habitat for Chinook Salmon and *O. mykiss* under the Bobcat Flat Phase III redesign, weighted usable area (WUA) was calculated. WUA curves depict a weighted measure of habitat for targeted species and life history stages at different flows and use species and life-stage specific habitat suitability

indices. Similar to the Bobcat Flat Phase III 100% designs, the evaluation focused on adult spawning habitat, and fry and juvenile rearing habitat and used the same habitat suitability indices (HSI) (USFWS 2010a, USFWS 2010b) and the same methodology for calculating WUA (McBain Associates 2021). For this evaluation we present spawning and rearing WUA curves and an accompanying table to help better illustrate the quantity (acres) of suitable habitat for each modeled flow.

2 SALMONID HABITAT EVALUATION AND DISCUSSION

Chinook Salmon spawning habitat curves showed a bimodal peak. One peak ranged from 300 to 550 cfs (3.1 acres) when flows are confined to the main channel, and one was in the upper range of modeled flows at 5,400 cfs (5.5 acres; Figure 1 and Table 1) when flows inundate gravel bars and floodplain surfaces. Since Chinook Salmon typically spawn from October to December in the Lower Tuolumne River when flows are < 1,000 cfs, they will benefit mostly from the available suitable spawning habitat in the lower range of modeled flows. *O. mykiss* spawning curves showed a steady increase in suitable spawning habitat, peaking at 5,400 cfs (8.0 acres; Figure 1 and Table 1) as hydraulic conditions in main channel increased in suitability and spawning areas on gravel bars and on floodplain surfaces were inundated.

In general, fry and juvenile rearing habitat curves increased as streamflows increased. Chinook Salmon and *O. mykiss* fry rearing habitat peaked at 3,000 cfs (21.7 acres) and 5,400 cfs (27.9 acres) respectively before gradually decreasing at higher flows when depth and velocities increased above the range of suitability for both species. Both Chinook Salmon and *O. mykiss* juvenile rearing habitat continued to increase as flow increased (Figure 2 and Table 1). Juvenile *O. mykiss* rearing habitat was greater than Chinook Salmon juvenile rearing habitat at all modeled flows since *O. mykiss* generally prefer higher velocities than Chinook Salmon juveniles, which is reflected in the HSI (USFWS 2010a).

At 300 cfs, a common annual recurrence flow and upper range of current spawning flows (McBain Associates 2021), the redesigned project will have approximately 10.8 acres of weighted usable combined spawning, and fry and juvenile rearing habitat for *O. mykiss*, and 10.9 acres of combined life-stage weighted usable habitat for Chinook Salmon. Therefore, the total weighted usable habitat that the project area is modeled to have at 300 cfs is 21.7 acres. At higher flows where greater side channel and floodplain inundation occurred, the combined suitable habitat is greater.

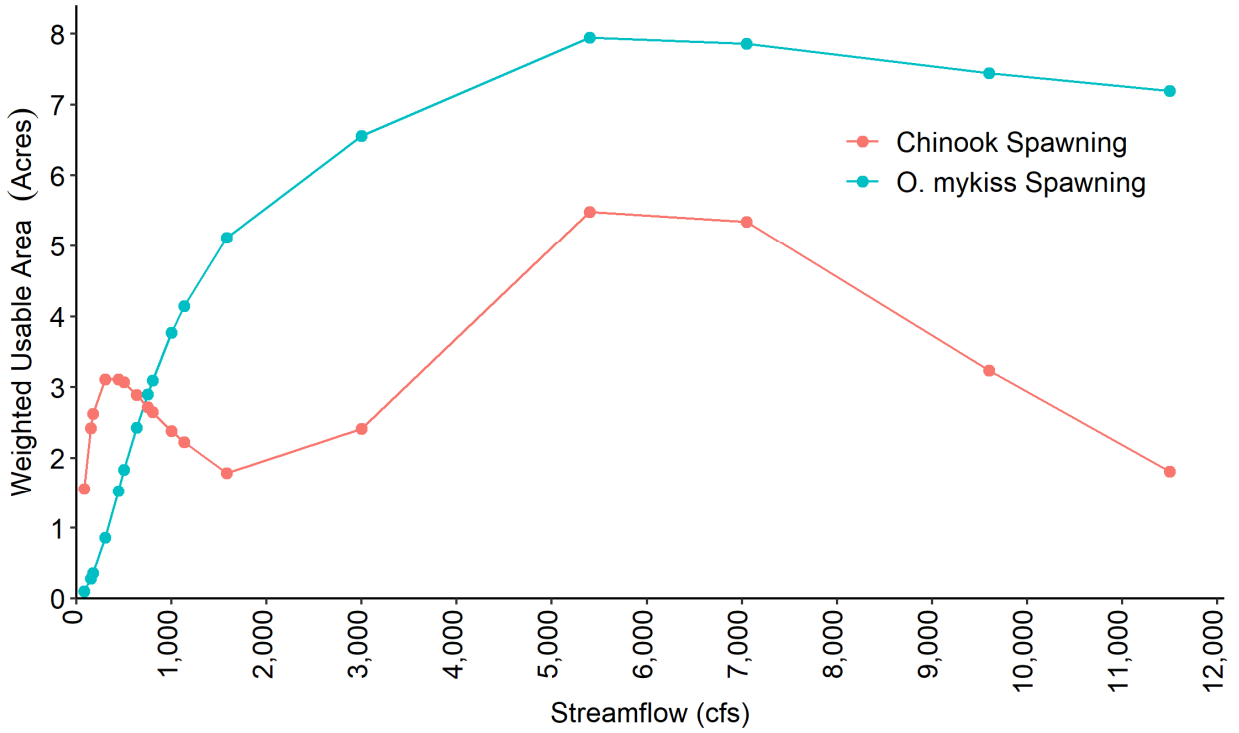

Figure 1. Redesign WUA (using depth, velocity, and substrate HSI) for Chinook Salmon and O. mykiss *spawning in the Bobcat Flat Phase III site.*

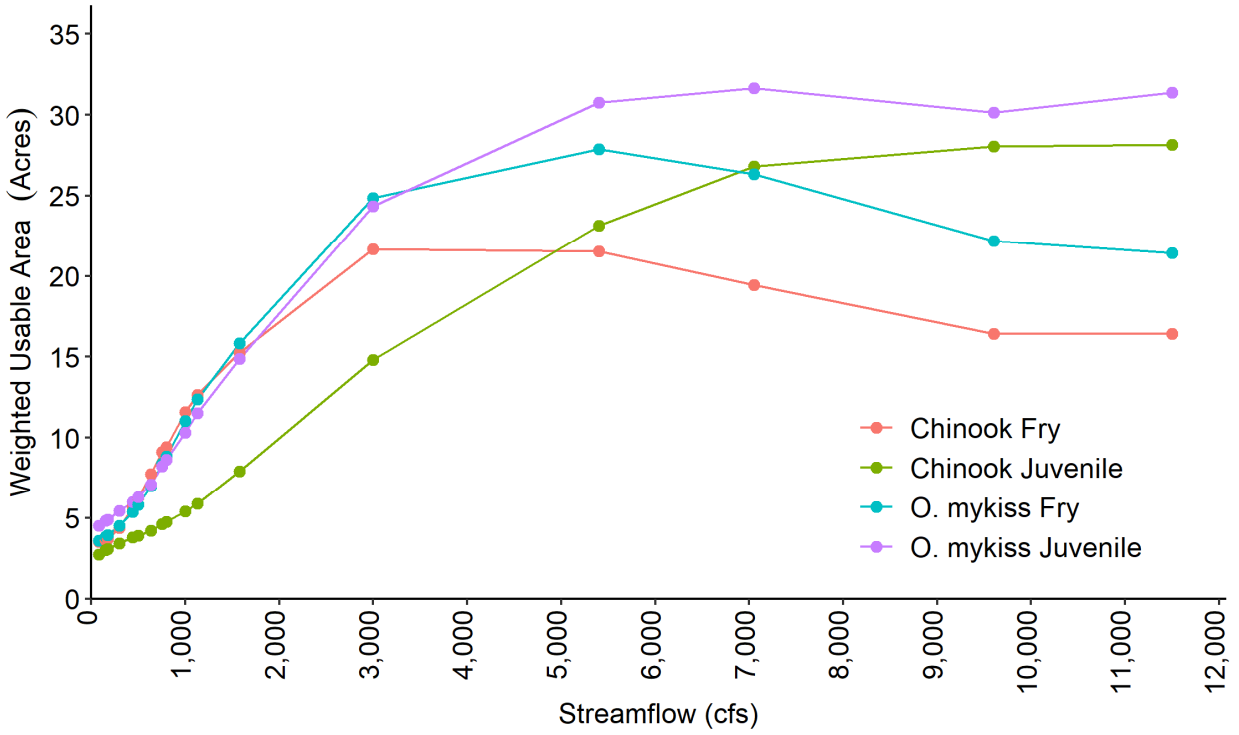

Figure 2. Redesign WUA (using depth, velocity, and cover HSI) for Chinook Salmon and O. mykiss *fry and juvenile rearing in the Bobcat Flat Phase III site.*

Table 1. Redesign WUA for Chinook Salmon and O. mykiss *spawning (using depth, velocity, and substrate HSI), and fry and juvenile rearing (using depth, velocity and cover HSI) in the Bobcat Flat Phase III site.*

	WUA in Acres at a Specified Flow					
Modeled Flow (cfs)	**Chinook Salmon Spawning**	**Chinook Salmon Fry Rearing**	**Chinook Salmon Juvenile Rearing**	***O. mykiss* Spawning**	***O. mykiss* Fry Rearing**	***O. mykiss* Juvenile Rearing**
80	1.6	3.5	2.7	0.1	3.6	4.5
150	2.4	3.6	3.0	0.3	3.8	4.8
175	2.6	3.7	3.1	0.4	3.9	4.9
300	3.1	4.4	3.4	0.9	4.5	5.4
440	3.1	5.7	3.8	1.5	5.4	6.0
500	3.1	6.3	3.9	1.8	5.8	6.3
633	2.9	7.7	4.2	2.4	7.0	7.1
750	2.7	9.1	4.6	2.9	8.4	8.2
800	2.7	9.4	4.8	3.1	8.8	8.6
1,000	2.4	11.6	5.4	3.8	11.1	10.3
1,130	2.2	12.6	5.9	4.1	12.4	11.5
1,580	1.8	15.2	7.9	5.1	15.9	14.9
3,000	2.4	21.7	14.8	6.6	24.9	24.3
5,400	5.5	21.5	23.1	8.0	27.9	30.8
7,050	5.3	19.4	26.8	7.9	26.3	31.6
9,600	3.2	16.4	28.1	7.4	22.2	30.2
11,500	1.8	16.4	28.1	7.2	21.4	31.4

2.1 Redesign Comparison to Existing Conditions and 100% Design

Due to several design modifications under the Bobcat Flat Phase III redesign, several considerations apply when comparing the redesign to existing conditions and 100% design: (1) Comparison of suitable fry and juvenile rearing habitat between the redesign and 100% design was not included in the evaluation because suitable habitat under 100% design was calculated for the entire Bobcat Flat Phase III project area, whereas the redesign was only for Groups A and B and gravel sourcing. As a result, a substantial side channel through the project site was not included in the redesign but was included in the 100% design. Therefore, comparing rearing habitat numbers between the 100% design and the current redesign was incongruent. (2) The D_{84} from finer sediment mix selected from the *Coarse Sediment Management Plan for the Lower Tuolumne River* (McBain and Trush 2004) was used to calculate spawning WUA under existing conditions and 100% design and translated into a higher suitability value for Chinook Salmon. The redesign used the D_{50} from the recommended finer sediment mix to calculate spawning WUA because previous spawning studies in the Lower Tuolumne used in the recent Tuolumne FERC relicensing, used the D_{50} to identify spawning locations (Stillwater Sciences 2013). The D_{50} translated into a higher suitability value for *O. mykiss* spawning and a decrease in suitability for Chinook Salmon spawning. Regardless of if the D_{50} or D_{84} were used to calculate spawning WUA, the recommended sediment mix includes gravels that provides suitable spawning sediment for both Chinook Salmon and *O. mykiss*; and therefore, actual Chinook Salmon spawning habitat will not suffer significant losses. (3) The terrain used for the existing conditions and 100% design model was updated with 2021 and 2022 bathymetry to improve modeling of the upstream area and slough entrance upstream of the project. This

change in the hydraulic model terrain resulted in changes in the modeled habitat in the neighboring landowner's slough that do not reflect changes as a result of the project.

The redesign increased spawning habitat as compared to existing conditions, except for flows at and above 3,000 cfs for Chinook Salmon spawning. However, spawning is unlikely to occur at 3,000 cfs and will have minimal effect on actual spawning conditions. Rearing habitat in the redesigned Bobcat Flat Phase III project was, in general, similar to existing conditions when comparing flow specific changes in habitat area (approximately ± 1 acre). Chinook Salmon fry and juvenile rearing habitat and *O. Mykiss rearing* habitat was increased under the redesign for upper- and lower-range flows when compared to the existing conditions. At mid-range flows of approximately 300 – 750 cfs, the redesign decreased fry and juvenile rearing habitat for both life stages, which is due to the updated bathymetry data in the neighboring landowner's slough and does not reflect changes as a result of this project. However, the focus of Bobcat Flat Phase III Part 1 was the construction of spawning habitat in the river channel, and juvenile and fry rearing habitat was relatively abundant under existing conditions and remained relatively abundant under redesign. While some side channel and floodplain features will also be constructed, these are incidental to the gravel sourcing for the in-channel features.

To enable comparison with the 100% design, which was calculated using D_{84} to map substrate, the redesign was re-run for Chinook spawning habitat using D_{84}. With this revision, the redesign increases spawning habitat at 150 cfs, approximately the low end of the spawning range, over both the existing conditions and the 100% design. At 300 cfs for the redesign, instead of 3.1 acres of Chinook spawning habitat using the D_{50} to assign substrate suitability, now 4.3 acres is calculated (Table 2). However – the other two factors described above – the large side channel not included in the redesign, and secondly the updated terrain surface – still apply. A large amount of low suitability spawning habitat is present in the 100% design in the side channel. In addition, riffle IC-1 is included in the 100% design but was not funded by CDFW in this implementation agreement (not part of Groups A and B). Since neither the side channel nor IC-1 are present in the redesign, this is understood to be the reason for the small 0.3 acre difference in suitable spawning habitat for Chinook between 100% design and redesign.

Table 2. Chinook Spawning WUA by flow under Existing Conditions, 100% design, and redesign (all using D_{84} to assign substrate suitability)

Flow (cfs)	Existing Conditions Suitable Habitat (acres)	100% Design Suitable Habitat (acres)	Redesign Suitable Habitat with D84 (acres)
50	0.7	1	-
80	-	-	2.0
150	1.4	3.1	3.2
300	1.4	4.6	4.3
440	1.3	5.0	4.4
750	1.1	4.7	3.9
1000	0.9	4.2	3.5
3000	3.0	4.3	3.2
5400	7.4	6.1	5.9
7050	7.7	5.5	5.6
9600	5.4	3.5	3.3

3 SUMMARY

As stated in the introduction, the CDFW grant agreement funded creation of 10.4 acres of spawning and rearing habitat. The redesigned project will excavate or add gravel to create 9.4 acres of in-channel feature areas, plus an additional 14.4 acres of floodplain and side channel feature areas. These combined total 23.8 acres, greater than the 10.4 acres stated in the CDFW grant agreement.

In addition, for Chinook salmon spawning, the redesign is anticipated to provide the same amount of habitat as the 100% design when both are evaluated using the D_{84}. Despite not including a substantial side channel or Riffle IC-1 (not funded by this CDFW implementation grant), the redesign provides more spawning habitat than the 100% design at the low end of spawning flows (approximately 150 cfs), and similar but slightly lower amounts at the high end of spawning flows.

4 REFERENCES

McBain Associates. 2021. Bobcat Flat Phase III 100% Design Report. Final Report, Prepared for Tuolumne River Conservancy, Stockton, CA.

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Stillwater Sciences. 2013a. Spawning Gravel in The Lower Tuolumne River Progress Report Don Pedro Project FERC No. 2299. Prepared for Turlock Irrigation District and Modesto Irrigation District.

U.S. Fish and Wildlife Service. 2010a. Flow-Habitat Relationships for Juvenile Fall/Spring-Run Chinook Salmon and Steelhead/Rainbow Trout Rearing in the Yuba River. U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Energy Planning and Instream Flow Branch, Sacramento, CA.

U.S. Fish and Wildlife Service. 2010b. Flow-Habitat Relationships for Spring and Fall-Run Chinook Salmon and Steelhead/Rainbow Trout Spawning in the Yuba River. U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Energy Planning and Instream Flow Branch, Sacramento, CA.